12 (1) (2025) 182 - 186

Journal of Physical Education, Health and Sport

https://journal.unnes.ac.id/journals/jpehs

The Application of Short Interval Training Method Based on High Maximum Aerobic Speed Capacity to Improve Aerobic Capacity

Sindy Fitri Yunita[1], Dikdik Zafar Sidik[2]✉, Fitri Rosdiana[3], Sendi Cornelia[4]

Physical Sports Coaching Study Program, Faculty of Sport and Health Education, Universitas Pendidikan Indonesia, Bandung, West Java, Indonesia[123]
Sports Education Study Program, School of Postgraduate Studies, Universitas Pendidikan Indonesia, Bandung, West Java, Indonesia[4]

History Article

Received July 2025
Approved July 2025
Published vol 12 no 1 2025

Keywords

Short Interval Training; Maximum Aerobic Speed; Aerobic Capacity.

Abstract

Aerobic capacity is a crucial component of an athlete's performance, especially in team sports like futsal, which require high endurance. Short Interval Training (SIT) has been widely used to improve aerobic capacity; however, individualized approaches based on Maximum Aerobic Speed (MAS) remain limited. This study aims to investigate the effect of a SIT program based on high MAS on the aerobic capacity among female futsal athletes. An experimental method with a one-group pretest–posttest design was used, involving five athletes from the Student Activity Unit at Universitas Pendidikan Indonesia. Participants underwent 16 training sessions over 8 weeks, with intensities set at ≥95% of each athlete's maximal effort. VO_2max was measured before and after the training program. Statistical analysis using a paired sample t-test showed a significant improvement in VO_2max from 39.39 to 40.73 ml/kg/min ($p = 0.004$, $p < 0.05$). This approach allows for better training precision and physiological adaptation by adjusting workloads according to each athlete's aerobic threshold. These findings indicate that SIT program based on high MAS is effective in improving aerobic capacity and enhancing recovery during the match. The results support the implementation of SIT program based on high MAS as an efficient and personalized training strategy for athlete conditioning programs.

How to Cite

Yunita, S. F., Sidik, D. Z., Rosdiana, F., & Cornelia, S. (2025). The Application of Short Interval Training Method Based on High Maximum Aerobic Speed Capacity to Improve Aerobic Capacity. Journal of Physical Education, Health and Sport, 12 (1), 182-186.

✉ Correspondence Author:
E-mail: dikdikzafarsidik@upi.edu

p-ISSN 2354-7901
e-ISSN 2354-8231

INTRODUCTION

Sports are regularly practiced by various groups for purposes including health, education, and athletes achievement. In Indonesia, many young athletes demonstrate great potential but are often limited by inadequate training facilities and structured coaching programs. According to Mubarok (2019), the development of athlete performance encompasses four key components: physical, technical, tactical, and mental. Among these, the physical aspect is fundamental to achieving success in sports performance (Prima & Kartiko, 2021).

A core indicator of physical fitness is aerobic capacity, which refers to the body's ability to sustain high-intensity activity over an extended period. However, in certain cases, the improvement of athletes' aerobic capacity encounters various constraints, leading to suboptimal outcomes. This limitation is primarily attributed to the implementation of aerobic training methods that are not tailored to the individual capabilities of the athletes. Aerobic capacity depends largely on VO_2max (maximum oxygen uptake), which measures the efficiency of the body in utilizing oxygen during intense exercise (Sidik & Rosdiana, 2022, 2023). VO_2max is influenced by factors such as age, sex, genetics, blood volume, mitochondrial efficiency, and physical training habits (Joyner & Dominelli, 2021).

Therefore, to improve aerobic capacity effectively, training must be structured, progressive, and tailored to individual ability. According to Sidik et al. (2019) outlined stages of aerobic endurance training, beginning with aerobic foundation and development, leading up to maximal aerobic training. These stages enable progressive physiological adaptation in both muscular and cardiopulmonary systems, promoting sustainable performance improvements.

One effective approach to improving aerobic performance is interval training, which involves repeated sessions of moderate to high intensity activity interspersed with recovery periods (Wilmor & Costil, 2008). This method can be adjusted based on work duration, intensity, repetition, recovery type and duration, and training frequency (Bilge, 2013). Based on workload duration, interval training is categorized into short, intermediate, and long interval training (Rushall & Pyke, 1990).

Short interval training features short bursts of high-intensity exercise (5–30 seconds) with recovery periods ranging from 15 to 150 seconds and training intensities exceeding 95% of maximal effort. This method targets anaerobic alactic endurance while simultaneously promoting aerobic adaptations (Driver, 2013; Rushall & Pyke, 1990). Although originally applied in elite athletic contexts, short interval training can also be adapted for beginners by adjusting training intensity gradually.

To ensure training precision and safety, the workload should match the athlete's physiological capacity. One of the most effective parameters for this is Maximum Aerobic Speed (MAS), the minimum speed at which VO_2max is reached during running (Thron et al., 2022). MAS is widely used to determine optimal training intensities and customize running sessions according to each athlete's aerobic potential (Bok et al., 2023; Tecco et al., 2022). This approach allows coaches to design training programs that are more efficient, targeted, and aligned with individual performance limits.

Although previous research such as that by Rønnestad et al. (2020) has shown that short interval training is more effective than long interval training in improving aerobic capacity among elite cyclists, those studies did not incorporate MAS in determining training intensity. This presents a relevant gap in the current body of knowledge.

Therefore, this study aims to investigate the effect of a Short Interval Training program based on high Maximum Aerobic Speed (MAS) on the aerobic capacity among female futsal athletes at the Student Activity Unit of Universitas Pendidikan Indonesia. These athletes possess adequate technical and tactical proficiency but require improvement in physical conditioning, particularly aerobic capacity. This individualized training approach is expected to significantly enhance aerobic performance in a structured and effective manner.

The novelty of this study lies in the application of short interval training tailored to individual Maximum Aerobic Speed (MAS). This approach allows training intensity to be precisely adjusted according to each athlete's physiological capacity, making the training more targeted and effective. Unlike previous studies by Rønnestad et al. (2020) and Gibala et al. (2006), which examined the effectiveness of short interval training in general without calibrating intensity based on MAS values, this study introduces a more adaptive model. By using MAS as the basis for determining workload, this research contributes a new perspective in

the development of performance-based training methods, particularly for improving aerobic capacity in female futsal athletes.

METHOD

This study employed an experimental research method aimed at assessing the effect of specific treatment on a particular variable. The research design used was One Group Pre-test–Post-test Design, where a single group is tested before and after the intervention (Yuwanto, 2019).

Table 1. One Group Pre Test-Post Test Design

Pre Test	Treatment	Post Test
O	x	o

O = Aerobic capacity measurement (Balke Test)
X = Treatment (Short Interval Training based on high MAS)

The population consisted of 30 female futsal athletes from the Student Activity Unit at Universitas Pendidikan Indonesia. A purposive sampling technique was used to select participants based on their high MAS category, as identified through the pre-test. According to Verducci in Pardilla et al. (2019), the top 27% of the group were selected, resulting in a sample size of 10. These participants were then further divided into two subgroups for experimental treatment, each comprising five individuals.

The Balke Test (15-minute run) was used to measure aerobic capacity. Participants were instructed to run continuously for 15 minutes around a 400-meter track, and the total distance covered was recorded. VO_2max was calculated using the following formula: VO_2max = (((Distance / 15) – 133) × 0.172) +33.3 (ml/kg/min) (Mackenzie,2005). The test has high validity (0.98) and reliability (0.85) (Mahardika, 2022).

The training program followed Short Interval Training principles adapted from Rushall & Pyke (1990), with intensities aligned to each athlete's maximal effort. Training characteristics included:

Table 2. Characteristics of Short Interval Training (Rushall & Pyke, 1990)

Component	Specification
Duration per repetition	5-30 seconds
Training intensity	≥95% of peak performance
Recovery duration	15-150 seconds
Work-to-rest ratio	1:3 to 1:5
Repetitions per session	5-20

The program was implemented over 16 sessions (twice per week for 8 weeks).

The research procedure included a pre-test, treatment phase, and post-test. The treatment sessions were designed based on high MAS values and conducted with structured progression. Data were then collected and analyzed using statistical procedures. Maximum aerobic speed can be calculated using the formula: maximum aerobic speed = distance (meters) / 900 seconds (using the Balke test) (Giriwijoyo & Sidik, 2010).

Data analysis involved the following steps:

1. Descriptive Statistics: to summarize central tendency and distribution characteristics (mean, median, SD, minimum, and maximum).
2. Normality Test: to assess data distribution using SPSS's Explore function with normality plots.
3. Hypothesis Testing: a paired sample t-test was conducted to compare pre- and post-test VO_2max scores, determining the significance of the training intervention.

.

RESULTS AND DISCUSSION

This study evaluated the effect of Short Interval Training based on High Maximum Aerobic Speed (MAS) on the improvement of aerobic capacity in female futsal athletes. The high MAS values of the participants ranged from 2.60 to 3.06 m/s, as calculated using the formula:

MAS = distance (meters) / 900 seconds (Giriwijoyo et al., 2009), based on the Balke Test results.

The average VO_2max increased from 39.39 to 40.73 ml/kg/min, suggesting a positive effect of the training intervention. A Shapiro–Wilk test confirmed that both pretest ($p = 0.546$) and posttest ($p = 0.459$) VO_2max scores were normally distributed ($p > 0.05$), allowing the use of parametric tests for further analysis. The results of the paired sample t-test revealed a statistically significant improvement in VO_2max after the intervention ($p = 0.004$, $p < 0.05$), indicating that the training program had a measurable and meaningful effect on aerobic capacity.

The results show that Short Interval Training (SIT) based on high Maximum Aerobic Speed (MAS) effectively improves aerobic capacity and enhances recovery during competition. Consistent with the definition proposed by Sidik et al. (2019), aerobic endurance refers to the body's ability to withstand fatigue during prolonged physical exertion and to recover efficiently in a short time. The mean VO_2max increased by 1.34 ml/kg/min following 8 weeks of training, reflec-

ting physiological adaptations such as improved cardiovascular efficiency and oxygen utilization.

The inclusion of high MAS values (ranging from 2.60 to 3.06 m/s) allowed training intensity to be precisely calibrated to each athlete's aerobic threshold. By prescribing training loads at ≥95% of each individual's maximal effort, the program ensured optimal aerobic stimulation while maintaining safety and efficiency. This aligns with findings from Thron et al. (2022) and Tecco et al. (2022), which emphasized the effectiveness of MAS-based training in endurance performance development.

Compared to previous studies like Rønnestad et al. (2020), which highlighted the benefits of SIT without MAS-based calibration, this study demonstrates the added value of individualizing intensity using high MAS to improve training outcomes. The consistent increase in VO_2max across participants, despite the small sample size (n = 5), suggests the reliability of the intervention model.

Overall, these findings support the implementation of short interval training based on high MAS in athlete conditioning programs, particularly in sports that demand high aerobic capacity, such as futsal. However, this study has limitations, particularly the small sample size, which restricts the generalizability of the findings. Additionally, data collection was conducted manually, which may affect measurement accuracy. Future research is recommended to utilize more advanced technology, such as heart rate monitors or GPS trackers, to facilitate data collection and improve the precision of training implementation and evaluation.

CONCLUSION

This study concludes that the application of Short Interval Training based on High Maximum Aerobic Speed (MAS) has a significant effect on improving aerobic capacity in female futsal athletes. The athletes demonstrated the ability to recover rapidly during the match. The training program led to a measurable increase in VO_2max after eight weeks of intervention. The individualized approach based on high MAS allowed for more accurate intensity regulation, promoting optimal physiological adaptations. These findings support the use of high MAS-based training as an effective strategy for enhancing aerobic performance and offer a valuable contribution to individualized conditioning programs in team sports.

REFERENCES

Bilge, M. (2013). Interval training specific to handball and training programme designs. World Applied Sciences Journal, 25(7), 1066–1077. https://doi.org/10.5829/idosi.wasj.2013.25.07.13363

Bok, D., Gulin, J., Škegro, D., Šalaj, S., & Foster, C. (2023). Comparison of Anaerobic Speed Reserve and Maximal Aerobic Speed Methods to Prescribe Short Format High-Intensity Interval Training. Scandinavian Journal of Medicine and Science in Sports, 33(9), 1638–1647. https://doi.org/10.1111/sms.14411

Driver, J. (2013). High Intensity Interval Training Explained.

Gibala, M. J., Little, J. P., van Essen, M., Wilkin, G. P., Burgomaster, K. A., Safdar, A., Raha, S., & Tarnopolsky, M. A. (2006). Short-term sprint interval versus traditional endurance training: Similar initial adaptations in human skeletal muscle and exercise performance. In Journal of Physiology (Vol. 575, Issue 3, pp. 901–911). https://doi.org/10.1113/jphysiol.2006.112094

Giriwijoyo, S., & Sidik, D. Z. (2010). Konsep dan Cara Penilaian Kebugaran Jasmani Menurut Sudut Pandang Ilmu Faal Olahraga. Jurnal Kepelatihan Olahraga, 2(1), 1–9.

Giriwijoyo, S., Sidik, D. Z., & Sagitarius. (2009). Dasar-Dasar Fisiologi Pelatihan Fisik (Meningkatkan Kemampuan Anaerobik dan Kemampuan Aerobik). Jurnal Kepelatihan Olahraga, 1(2), 65–74.

Joyner, M. J., & Dominelli, P. B. (2021). Central Cardiovascular System Limits to Aerobic Capacity. Experimental Physiology, 106(12), 2299–2303. https://doi.org/10.1113/EP088187

Mahardika. (2022). Pengaruh Latihan Circuit Training dan Interval Training Terhadap Daya Tahan Aerobic Pada Fisik Atlet Sepak Bola Putra Squad FC U-19. Seminar Nasional Keindonesiaan (FPIPSKR), 2022: Seminar Nasional Ke Indonesiaan VII, 2010–2016. https://conference.upgris.ac.id/index.php/snk/article/view/3414

Mubarok, M. Z. (2019). Pengaruh Latihan Small Sided Games Mengunakan Metode Interval Terhadap Peningkatan Dribbling Pemain Sepakbola. Biormatika: Jurnal Ilmiah Fakultas Keguruan Dan Ilmu Pendidikan, 5(02), 144–149. https://doi.org/10.35569/biormatika.v5i02.513

Pardilla, H., Hanif, A. S., Humaid, H., Tangkudung, J., Henjilito, R., Siregar, S., & Bon, A. T. (2019). Model of Triple Jump Achievment: The Effect Method Learning and Motor Skills Youth 18-20 Age. Proceedings of the International Conference on Industrial Engineering and Operations Management, 2047–2053.

Prima, P., & Kartiko, D. C. (2021). Survei Kondisi Fisik Atlet Pada Berbagai Cabang Olahraga. Jurnal Pendidikan Olahraga Dan Kesehatan,

9(1). https://ejournal.unesa.ac.id/index.php/jurnal-pendidikn-jasmani/issue/archive

Rønnestad, B. R., Hansen, J., Nygaard, H., & Lundby, C. (2020). Superior Performance Improvements in Elite Cyclists Following Short-Interval vs Effort-Matched Long-Interval Training. Scandinavian Journal of Medicine and Science in Sports, 30(5), 849–857. https://doi.org/10.1111/sms.13627

Rushall, B. S., & Pyke, F. S. (1990). Training for Sports and Fitness. Macmillan Co. of Australia. https://lccn.loc.gov/91172614

Sidik, D. Z., Pesurnat, P. L., & Afari, L. (2019). Pelatihan Kondisi Fisik (Nita, Ed.; Cetakan Pertama). PT Remaja Rosdakarya.

Sidik, D. Z., & Rosdiana, F. (2022). The Improvement of Power Endurance and Aerobic through Interval Method by Using Vest Jackets. International Journal of Human Movement and Sports Sciences, 10(3), 469–475. https://doi.org/10.13189/saj.2022.100314

Sidik, D. Z., & Rosdiana, F. (2023). Reverse Periodization Model to Increase Anaerobic and Aerobic Capacity. International Journal of Human Movement and Sports Sciences, 11(1), 65–70. https://doi.org/10.13189/saj.2023.110108

Tecco, J. M., Gerard, N., & Badr, D. A. (2022). Running to Prevent Depression; Maximal Aerobic Speed for Adolescents in The South of Belgium. Comparison with Thein and The Impact on Their Physical and Mental Health. Psychiatria Danubina, 34. https://europepmc.org/article/med/36170696

Thron, M., Woll, A., Klos, L., Härtel, S., Ruf, L., Kloss, C., & Altmann, S. (2022). Overestimation of Maximal Aerobic Speed by the Université de Montréal Track Test and a 1500-M-Time Trial in Soccer. Frontiers in Physiology, 13. https://doi.org/10.3389/fphys.2022.1023257

Wilmor, J. H., & Costil, D. L. (2008). Physiology of Sport and Exercise (4th ed.). Human Kinetics.

Yuwanto, L. (2019). Pengantar Metode Penelitian Eksperimen (2nd ed.). Graha Ilmu. https://doi.org/https://isbn.perpusnas.go.id/Account/SearchBuku?se...